

Numerical modelling of rolled plug installation inside steam generator tube

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Nuclear power plants represent safe and reliable source of electrical energy with low carbon emissions. Steam generator tubes represent critical component in nuclear power plant as they form boundary between primary circuit with radioactive water and secondary circuit with clean water. Rolled plugs are used for defected steam generator tubes plugging by forming leak tight seal with the tube to prevent leakage of radioactive water from primary circuit into the environment. Proper installation and formation of leak tight seal between rolled plug and tube is of pivotal role.

Installation of rolled plug is performed by roll expansion process. Roll expansion uses rollers which are rotating and radially expanding rolled plug shell to form a leak tight seal with defected steam generator tube. Numerical modelling of roll expansion process is essential to accurately determine the impact roll expansion process has on the formation of leak tight seal and also to determine stress distribution and impact process has on the rolled plug structural integrity. Impact of the contact area between rolled plug and tube also causes stress distribution inside the tube and tube sheet [1]. Additionally, by implementation of phase field method to determine damage levels in rolled plug provides additional layer of information rolled plug installation process has on the rolled plug structural integrity, especially in area where significant radial expansion occurs.

Numerical modelling of roll expansion process allows to determine proper roll expansion parameters [2]. Determined roll expansion parameters are used for numerical modelling of rolled plug installation with aim to form a proper leak tight seal with the tube and prevent radioactive water leakage but also to have a minimal impact on the tube and tube sheet structural integrity.

This paper presents numerical modelling of roll expansion process which includes non-linear analysis, contact analysis and simulation of complex roller kinematics and results analysis of overall impact of the roll expansion process.

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